“DESIGN AND FABRICATION OF ATTACHMENT MADE FOR LATHE MACHINE”

Submitted By

Shohin Naik (13ME96)
Toufik Pathan (13ME99)
Vaibhav Patil (13ME100)
Swarupanand Lugade (13ME121)

UNDER THE GUIDANCE Of Prof. ASLAM HIRANI
Overview

- Introduction
- Problem definition
- Aim/Objective
- Literature survey
- Total cost of the project
- Methodology
- Experimentation
- Result and Conclusion
- Future scope

References
Introduction

Tool Post Grinder

The tool post grinder is a portable grinding machine that can be mounted on the compound rest of a lathe in place of the tool post. It can be used to machine work that is too hard to cut by ordinary means or to machine work that requires a very fine finish.

Its consists of

- High rpm (around 2880), three phase, AC motor
- V-belt
- Two pulleys for holding belt
- Grinding wheels
- Shaft with bearing block to support it.
Cylindrical Grinding

Cylindrical Grinding is defined as grinding the periphery of rigidly supported and rotating work piece. It generally refers to work that is ground when held between center and chuck.

External grinding.

Internal grinding.
We have focused our study in development of such a grinding setup which gets fit in the available space of lathe machine without having the need of removing the tool post also the cost of this grinding setup is way less as compared to that of the available grinding machine in the market. Our grinding setup will be capable of performing cylindrical grinding operations and also there will be no interference of our grinding setup with the conventional operations on lathe machine such as turning, facing etc.
Problem Definition

- For doing grinding operation on a workpiece it is needed to load and unload the workpiece from lathe machine to this grinding setup’s which consumes considerable amount of time.
- Due to the time lost in loading and unloading of workpiece, there is a decrease in rate of production of the workpiece.
- The cost and space taken by this grinding setups is hindrance for small scale industrialists.
- The space available on light duty lathe machine in front of the tool post was not utilized properly.
Aim/Objective

AIM:
- To design and fabricate grinding attachment for lathe.

OBJECTIVE:
- To manufacture an attachment for lathe which perform grinding operations.

PURPOSE OF THE STUDY:
- To minimize time by 2-3 min per job of equipment’s and workers.
- To perform grinding operations on single shaft such as external, internal. With work piece material as mild steel.
Literature Review

The Overview of literature review is as follows:

- **Market Survey** - To Find the cost of various components and material with their availability.
- **Industrial Survey** - To find if the Project we are making is already available in the firms and also to find the commercial aspects of our project.
- **Expert Advice** - To take help from people who are expert in the field of our project.
- **Internet Survey** - To find various information needed from time to time.
# Total Cost Of The Project

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>COMPONENT</th>
<th>MATERIAL</th>
<th>QUANTITY</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Motor (Three phase AC 0.5 HP, 1440 RPM)</td>
<td>Cast Iron Body</td>
<td>1</td>
<td>2700</td>
</tr>
<tr>
<td>2</td>
<td>Small V-Belt Pulley ϕ50mm</td>
<td>Cast Iron</td>
<td>1</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>Large V-Belt Pulley ϕ100mm</td>
<td>Cast Iron</td>
<td>1</td>
<td>160</td>
</tr>
<tr>
<td>4</td>
<td>V-Belt A-25</td>
<td>Oleo static</td>
<td>1</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>Item Description</td>
<td>Material</td>
<td>Quantity</td>
<td>Unit Cost</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------------</td>
<td>----------------</td>
<td>----------</td>
<td>-----------</td>
</tr>
<tr>
<td>5</td>
<td>Shaft (ϕ20mm, L=310 mm)</td>
<td>Mild Steel</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>Grinding Wheel (D=150mm, d=32mm, width=20 mm)</td>
<td>Aluminum Oxide Abrasive</td>
<td>1</td>
<td>250</td>
</tr>
<tr>
<td>7</td>
<td>Plumber Block (P204)</td>
<td>Cast Iron</td>
<td>2</td>
<td>400</td>
</tr>
<tr>
<td>8</td>
<td>Baseplate (190.05mm<em>108mm</em>16m)</td>
<td>Mild Steel</td>
<td>1</td>
<td>190</td>
</tr>
<tr>
<td>9</td>
<td>Rotary Base Plate (177.80mm<em>101.60mm</em>8 mm)</td>
<td>Stainless Steel</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>10</td>
<td>Mounting Plate (177.80mm<em>152.40mm</em>6m)</td>
<td>Mild Steel</td>
<td>1</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>11</td>
<td>L-Angle</td>
<td>Mild Steel</td>
<td>8</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>(L= 160mm, t=5 mm, b = 20 mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Isolators</td>
<td>Rubber</td>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>(150x150x10 mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Bolts &amp; Nuts</td>
<td>Cast Iron</td>
<td>8</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>(M8,M10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>COST</td>
<td>4450</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>other operational cost</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(welding)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL COST</td>
<td>4850/-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This total cost can be reduced to 20% if this machine made in mass production because the machining cost would be very less and material cost would be less if bought is bulk.
Methodology

- Idea about project
- Information collection
- Literature review
- Gap analysis
- Problem definition
- System identification
- Parameter selection
- Material selection
- Cost estimation
- CAD design and analysis
- Manufacturing
Methodology

- Design Methodology
  - Selection Of Grinding Wheel
  - Design of fixture Based on Specification Of Lathe Machine
  - Calculation based selection of components
    - Motor
    - V- Belt Pulley
    - Belt
    - Design of Shaft
    - Selection of Bearing and Bearing Block

- Software Analysis

- Fabrication

- Experimentation
Specifications of Grinding Wheel:

- **Abrasives**: Aluminum Oxide
- **Grit**: selected Grit is 60.
- **Grade**: grade K is selected
- **Structure**: Dense
- **Bond**: Vitrified bond

- 150 mm Diameter
- 20 mm Thickness
- 31.75 mm Bore
- Max. Speed 33 m/s
Grinding Parameters:

- **Cutting Speed**:
  \[ V = \frac{\pi D N}{60} = \frac{\pi \times 150 \times 2880}{60} = 22.61 \text{ m/sec} = 1357.16 \text{ m/min} \]

- **Feed Rate**: 1 mm per sec = 0.1071 mm/min

- **Depth of Cut**: ranging 0.005 to 0.04 mm

- **Grinding time**:
  \[ T = \frac{L \times i}{\text{feed per rpm} \times \text{rpm of job}} = 4.168 \text{ min} \]

- **Material Removal Rate**:
  \[ \text{MRR} = v \times b \times d = 10.64 \text{ mm}^3/\text{sec} \]
### Specification Of Lathe Machine

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lathe machine size</td>
<td>4’6”</td>
</tr>
<tr>
<td>Height of center</td>
<td>6(1/2)”</td>
</tr>
<tr>
<td>Spindle bore</td>
<td>38 mm</td>
</tr>
<tr>
<td>Electric motor</td>
<td>1 HP 3 PHASE</td>
</tr>
<tr>
<td>Belt type</td>
<td>V-belt</td>
</tr>
<tr>
<td>R/F Switch</td>
<td>-</td>
</tr>
<tr>
<td>Chuck</td>
<td>3 JAWS</td>
</tr>
<tr>
<td>True chuck</td>
<td>165 mm</td>
</tr>
</tbody>
</table>
Design Of Fixture

Components of fixture

- **Base Plate** (190.05 mm* 108 mm *16 mm)
- **Rotating Plate** (177.80 mm*101.60 mm *8 mm)
- **Mounting Plate** (177.80 mm*152.40 mm*6 mm)
- **L- Angle**
- **Height Block For Bearing House (P204)**

layout of fixture
weight of fixture=7.3 kg
maximum load capacity of fixture=1000 N
Design Calculations

1. Motor Selection:
3 Phase AC motor
P = 0.5 HP
\(N_M = 1440\) RPM
desired speed 2880 rpm Achieved by Belt Pulley Transmission.

2. Selection of Standard V-belt
CATEGORY OLEO STATIC A-25
3. Selection of Standard V-belt Pulley:

\[ D_1 = \text{Diameter of Larger Pulley} = 4 \text{ Inch} \]
\[ D_2 = \text{Diameter of Smaller Pulley} = 2 \text{ Inch} \]

4. Selection of Shaft:

Material selection for shaft

**Mild Steel ASTM-A-36**

\[ \sigma_{ut} = \text{Ultimate Tensile Strength} = 450 \text{ MPa} \]
\[ \sigma_{yt} = \text{Yield Tensile Strength} = 250 \text{ MPa} \]
\[ \Gamma_d = 0.3*\sigma_{yt} = 0.3*250 = 75 \text{ N/mm}^2 \]
F.B.D. Of Shaft

Horizontal Force Diagram:
- FG = 100 N
- RAH
- RBH
- WG = 110 N
- 100 N
- RAV
- RBV
- WP = 10 N

Vertical Force Diagram:
- 110 N
- 182.8 N
- 262.8 N
- 190 N

Conditions:
- $T_1 + T_2 = 200$ N
Bending Moment Of Shaft

HORIZONTAL MOMENT DIAGRAM

\[ M_{AH} = 7200 \]

\[ M_{AV} = 7920 \text{ N} \]

\[ M_{BV} = 49935.8 \text{ N} \]

VERTICAL MOMENT DIAGRAM

\[ M_A = 10703 \text{ N} \]

\[ M_B = 49935.8 \text{ N} \]

RESULTANT MOMENT DIAGRAM
Calculation For Diameter Of Shaft

According to Maximum Principal Shear Stress Theory,

\[
\Gamma_d = \frac{16}{\pi d_s^3} \sqrt{(k_b \cdot M_b)^2 + (k_t \cdot M_t)^2}
\]

\[
75 = \frac{16}{\pi d_s^3} \sqrt{(1.5 \cdot 49935.8)^2 + (1 \cdot 2473.53)^2}
\]

\[d_s = 17.20 \text{ mm}\]

Taking Diameter of Shaft \(d_s = 20\ \text{mm}\)

\[
\Gamma = \frac{16}{\pi \cdot 20^3} \sqrt{(k_b \cdot M_b)^2 + (k_t \cdot M_t)^2}
\]

\[
\Gamma = \frac{16}{\pi \cdot 20^3} \sqrt{(1.5 \cdot 49935.8)^2 + (1 \cdot 2473.53)^2}
\]

\[\Gamma = 47.71\ \text{N/mm}^2\]

\[\Gamma = 47.71\ \text{N/mm}^2 < \Gamma_d = 75\ \text{N/mm}^2\]

hence, it is safe.
5. Selection of Bearing Block

Based on calculation we have selected ball bearing.

- **Specifications of bearing**
- SKF 6204
- \( C = 1000 \text{ kgf} \)
- \( C_0 = 655 \text{ kgf} \)
- Max. Permissible speed = 16000 rpm

![Dimension of Bearing 6204](image)
Assembling Of Components To Make Cylindrical Grinding Attachment
Fabrication Procedure

- Design Fixture And Fabrication
  - C-slot For Angular Grinding
  - Arrangement Made For Belt Tightening
- Motor mounting on fixture
- Belt pulley arrangement
- Bearing house fix on block
- Attachment Of Grinding Wheel On Shaft
- Attachment Of Shaft And Bearing
- Attachment Of Fixture On Lathe Cross Slide
- Aesthetics
Experimentation

Diameter of raw work piece -

\( D_{\text{raw}} = 24 \text{ mm} \)

\( L_{\text{raw}} = 102 \text{ mm} \)

Operations perform on raw material

Facing B. Turning C. Cylindrical Grinding

1. First two operations A and B performed on lathe machine and grinding operation performed cylindrical grinder

2. All operations A, B and C performed on lathe machine

Description of Work piece:

Length of Job (L) : 100 mm
Diameter of Job (D) : 20 mm
Rpm of Job (N) : 560 rpm
Rpm of Grinding Wheel : 2880 rpm
Depth of Cut (mm) : 0.005 mm
Feed (mm/Rev) : 0.1071 mm/rev

All Dimensions in mm
### Observation Table for Time:

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>PARAMETERS</th>
<th>CONVENTINAL GRINDING TIME (min)</th>
<th>GRINDING ATTACHMENT TIME (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SETUP TIME</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A. Unloading Job from Lathe M/C</td>
<td>0.233</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>B. Travelled Time</td>
<td>0.450</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>C. Loading of Job</td>
<td>0.916</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>D. Job Clearance</td>
<td>0.366</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>E. Other Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I. set up time</td>
<td>0.166</td>
<td>0.216</td>
</tr>
<tr>
<td></td>
<td>II. Inspection Time</td>
<td>0.208</td>
<td>0.208</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>2.339</td>
<td>0.424</td>
</tr>
</tbody>
</table>
2. **OPERATION TIME**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. M/C Time</td>
<td>9.6</td>
<td>9.6</td>
</tr>
<tr>
<td>B. Unloading Time</td>
<td>0.233</td>
<td>0.233</td>
</tr>
</tbody>
</table>

3. **MISCELLANEOUS TIME**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Checking and Inspection</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td>B. Fatigue Allowance</td>
<td>0.48</td>
<td>0.48</td>
</tr>
<tr>
<td>C. Preposition of Operator on Lathe</td>
<td>0.45</td>
<td>0</td>
</tr>
</tbody>
</table>

**TOTAL TIME (1+2+3)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( T_1 = 14.062 )</td>
<td>( T_2 = 11.697 )</td>
</tr>
</tbody>
</table>

**TOTAL TIME SAVE FOR ONE JOB** \( T_{\text{save}} = T_2 - T_1 \)

\( T_{\text{save}} = 2.365 \text{ min} \)

For production of **100 jobs** time saving goes to more than **3.5 hours** in a day
Surface roughness tester

<table>
<thead>
<tr>
<th>SR. NO</th>
<th>PARAMETERS</th>
<th>CONVENTIONAL CYLINDRICAL GRINDING ROUGHNESS (microns)</th>
<th>GRINDING ATTACHMENT ROUGHNESS (microns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$R_a$ (Arithmetic mean deviation)</td>
<td>6.575</td>
<td>17.83</td>
</tr>
<tr>
<td>2</td>
<td>$R_z$ (maximum height of roughness)</td>
<td>18.59</td>
<td>28.92</td>
</tr>
<tr>
<td>3</td>
<td>$R_q$ (root mean square deviation)</td>
<td>6.74</td>
<td>14.15</td>
</tr>
<tr>
<td>4</td>
<td>$R_t$ (total height of roughness profile)</td>
<td>18.77</td>
<td>53.25</td>
</tr>
</tbody>
</table>
Results

TIME

- Time is the most important factor affecting every manufacturing process. Manual grinding machines are mounted at specific locations and we have to take the job at that location and have to do the grinding process. It consumes time as compared to grinding wheel attachment. It has an easy setup and requires removing the check post of the lathe. It consumes less time than manual grinding process. After successful operations, we saved 2.365 min per job for the above-mentioned dimensional job. For production of 100 jobs, time saving goes to more than 3.5 hours in a day.
ACCURACY

- For attaining highest surface accuracy up to 20 microns if we compare manual grinding process with our attachment of grinding wheel on lathe for manual grinding process we have to remove job from chuck of lathe and have to be take up to that grinding machine which is mounted at specific location in workshop it affects the accuracy of final product because of human errors.

- Surface finish is good in special purpose cylindrical gridding machine which is 6.74 microns whereas on grinding attachment is 14.15 microns. We achieved desired roughness in range of 10-20 microns. Rather than if we used same parameter in both machining process like feed, rpm, cutting speed, grinding wheel for same job then we can achieved same roughness in both cases.
Conclusion

- Human efforts will get reduced.
- Time for production will decrease by 2.365 min for one job.
- Angular grinding gets done on set up.
- Cost of equipment’s will get reduced considerable.
- Desired surface finish will be achieved 10-20 microns.
- Production rate will get increased.
Future Scope’s

- This attachment can be modified for different material with different shape and size.
- Milling, drilling, operations can be made possible by suitable modifications.
- Hydraulic system can be implemented for height adjustment for these attachments.
- Taper grinding can be done by attachment of taper cross-slide attachment on lathe.
- These attachment can be used in small scale industry.
- By modifying base plate it can be attached on any type of lathe machine.
References

**Standard Books:**

- Production Technology By R.K. Jain
- Design Data, P S G College Of Technology.
- Wikipedia and Google Scholar.
- Machine Design By Bhandari
- Lewis Et Al.1959; And Robert Et Al., 1964).
**Journal Papers:**

- DESIGN AND FABRICATION OF GRINDING ATTACHMENT FOR LATHE MACHINE TOOL (International Journal of Science, Technology & Management Volume No.04, Issue No. 04, April 2015)


- PREDICTION AND OPTIMIZATION OF CYLINDRICAL GRINDING PARAMETERS FOR SURFACE ROUGHNESS USING TAGUCHI METHOD (IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)

- FABRICATION OF CYLINDRICAL GRINDING ATTACHMENT ON LATHE MACHINE AND OPTIMIZATION OF GRINDING PARAMETERS BY REGRESSION (ISSN 2278 – 0149 www.ijmerr.comVol. 4, No. 1, January 2015© 2015 IJMERR.)
PUBLICATION OF PAPER

The paper titled “Increase in productivity by attachment of grinding setup on lathe machine” publishing in the IOSR Journal (current status – manuscript id-cp72194)
Thank you